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ABSTRACT

This lesson is an introduction to the operation of filter presses. Two basic types of presses, their components, the sequence of operation, operational controls, sampling, and testing are discussed. The instructor's manual contains a description of the lesson, estimated presentation time, instructional materials list, suggested sequence of presentation, reading lists, objectives, lecture outline, narrative of the slide/tape program used with the lesson, and student worksheet (with answers). The student workbook contains plant flow diagrams, objectives, glossary, text material, references, and worksheet. Text material is presented in five sections titled: filter press basics, equipment, operational controls, and sampling and testing. (Author/JN)

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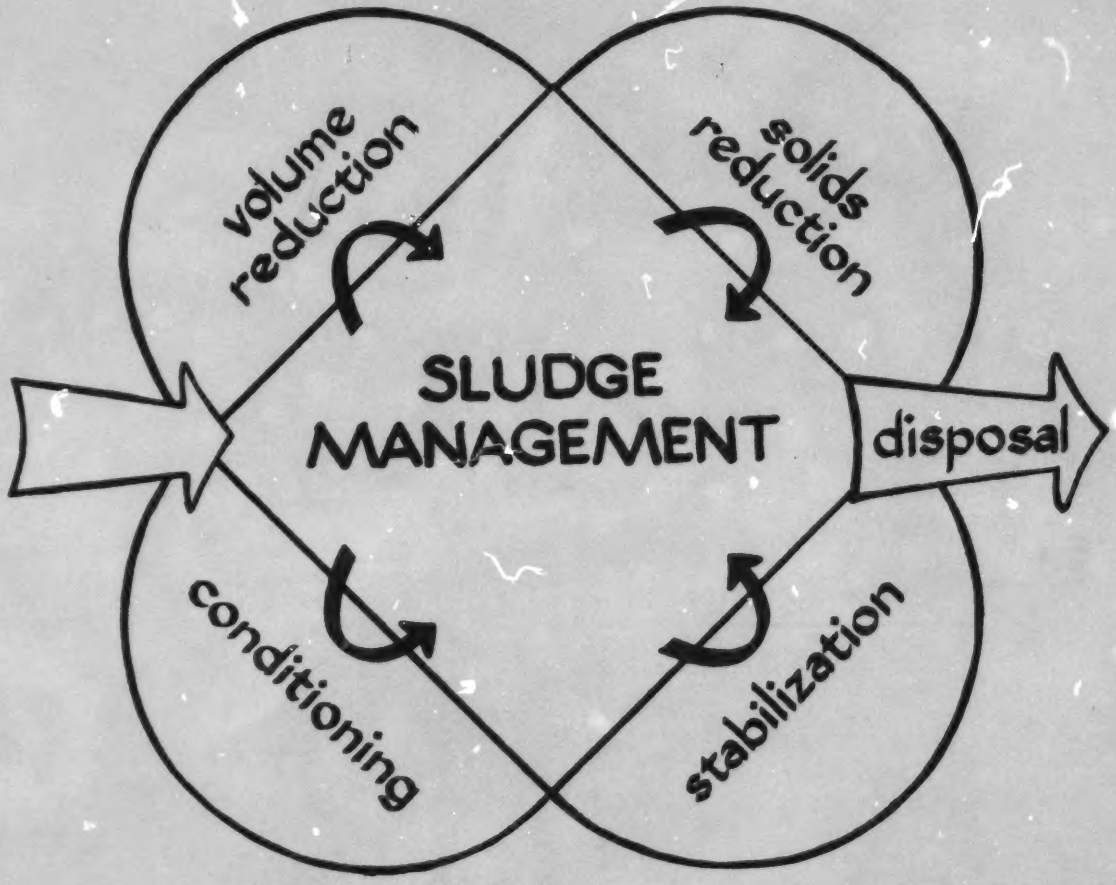
SLUDGE TREATMENT

and

DISPOSAL

COURSE # 166

FILTER PRESSES



INSTRUCTOR'S GUIDE

Prepared by
Linn-Benton Community College
and
Envirotech Operating Services

SE040062

FILTER PRESSES

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FILTER PRESS
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FILTER PRESS

Lesson Description

This lesson is an introduction to the operation of the filter press. The lesson discusses the two basic types of presses, their components, the sequence of operation, operational controls, sampling and testing.

Estimated Time

Student preview	5-10 minutes
Presentation of material	14 minutes
Open discussion	10-20 minutes
Worksheet	10-15 minutes
Correct the worksheet	10 minutes

Instructional Aids

1. Student text "Pressure Filters"
2. Slides "Pressure Filters"
3. 35 mm slide projector
4. Screen
5. Samples of cake, filtrate, and filter media

Suggested Sequence of Presentation

1. Assign reading - special emphasis on objectives and glossary
2. Present lesson
3. Open discussion - show samples of cake, filtrate and filter media
4. Assign worksheet
5. Correct worksheet

Required Reading

Student text "Filter Presses"

Reference Reading

MOP Operations of Wastewater Treatment Plants, pages 314-316.

Objectives

Upon completion of this lesson, the student should be able to do the following:

1. Recall that the filter press is a volume reduction device
2. Recall that the filter press usually requires pretreatment
3. Define binding
4. Define precoat
5. Recall two precoat materials
6. Recall that the filter press is a batch process
7. Identify the basic components of the two basic types of filter presses
8. Describe the sequence of operation of the filter press
9. Recall two materials that are used to produce filter cloths
10. Recall the typical operating pressure range for a filter press
11. State the approximate thickness of cake for the two different filter press types
12. Describe how to determine when the cycle is completed
13. Recall typical cake solids percentage
14. Recall typical solids recovery
15. Given one of the operational variables, describe how its change will effect solids cake and filtrate quality
16. Identify sampling points and basic control test
17. Identify five items which must be included in daily trend charts.

FILTER PRESS

LECTURE OUTLINE

I. BASICS

A. History

1. Europe
2. 1860

B. Volume Reduction

1. Reduction of water
2. Containing sludge within a filter cloth.
3. The cloth placed between two rigid plates - static system.
4. Pressure applied to sludge via a pump.
5. Squeeze the liquid from the sludge.
6. Sludge cake
7. Filtrate - returned to the plant.
8. Usually preceded by conditioning.

C. Batch Process

II. EQUIPMENT

A. Two Types

1. Plate & frame
2. Recessed plate

B. Recessed Type 0.75 - 1.5 Thick Cake

1. Legs - steel
2. Side bars - steel
3. Head - cast iron
4. Follower - cast iron
5. Closing mechanism

a) 3500 psi

6. Recessed plates - grooves
    a) Cast iron
    b) Polypropylene
    c) Steel/rubber
    d) Center feed
7. Filter media - cloth
    a) Cloth - nylon, orlon, dacron
    b) Paper
    c) Felt
    d) Polypropylene, polyvinylchloride
8. Pump - 100-225 psi
    a) Diaphram - air operated
    b) Piston ran
9. Pretreatment Equipment
    a) Precoat
        1) Fly ash
        2) Diatomaceous earth
        3) Reduce cleaning
        4) Reduce binding
    b) Conditioning

C. Plate and Frame 1" - 5" Cake
1. Same basic equipment
    a) Legs
    b) Side bars
    c) Head

d) Follower

e) Closing mechanism

f) Filter media

g) Pump

h) Pretreatment

2. Plates & frames

a) Alternate

b) Media over plate

c) Frame controls cake thickness

d) Corner or side feed

III. PROCEDURE

A. Close Press

B. Mix Precoat if Used

C. Condition Sludge

1. Ferric chloride, lime, alum, polymers

2. Flash mix

3. Slow mix

4. Settling

5. Supernatant to plant

a) Check BOD, SS and VSS

6. Jar Test

D. Apply precoat

E. Apply sludge

1. Low pressure - high rate
25 psi - 2,000 -3,000 gpm

2. Increase at 5 psi every few minutes.

3. Operating pressure
   100 - 225 psi - 1/4 to 1/3 of run

4. Filtrate flow measured high. Drops rapidly. Then levels off.

5. Complete when filtrate rate 10 - 20 ml/min./ft.^{2}

   a) Returned to plant

6. 2 - 4 hours

F. Bleed Off Pressure

G. Drop Cake

1. 20 - 55% solids

2. 90 - 99% solids recovery

H. Clean Media

1. Binding

2. Acid wash

I. Restart Run
   Yield 0.1 to 1 lbs./hr./sq. ft.
   Depending upon solids type and conditioning

IV. OPERATIONAL CONTROLS

A. Goals

1. Filter cake quality

2. Filtrate quality

B. Controls

1. Pressure

2. Dosage

3. Cycle time

C. Interrelated

1. Higher pressure

   a) Requires better floc quality

b) Reduces cycle time

c) Drier cake

2. Reduced Dosage

a) Lengthen cycle time

b) Controlled by feed solids

c) Reduction in feed solids

1) Increase in chemicals

3. Cycle time

a) Decrease in rate of cycle - (longer time)

b) Drier solids

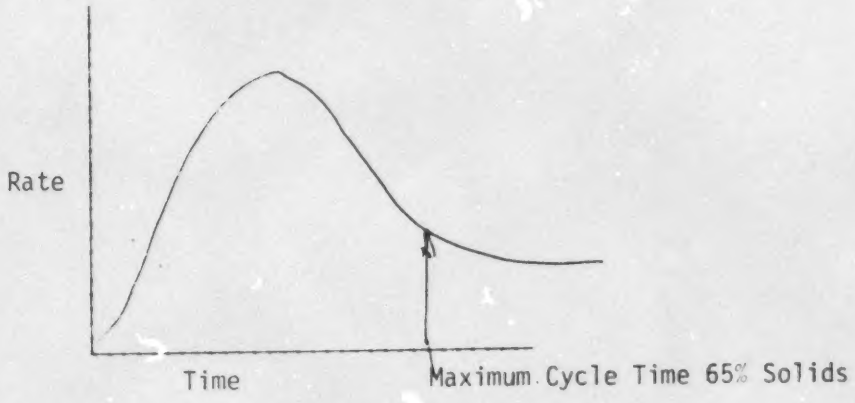
c) More cost/ton

D. Optimum Sludge Cake

1. Prediction of % cake solids

a) Filtrate rate decrease
solids cake increase

b) Plot filtrate rate versus time



FILTER PRESS - LECTURE OUTLINE

V. SAMPLING TESTING - SAMPLE EACH CYCLE

A. Total Solids compared
Raw, filtrate, cake

B. Volatile Solids
Raw, filtrate, cake

C. pH
Raw, filtrate

D. Alkalinity and Dissolved Solids - Raw

E. Plotting Trend Charts - Daily

1. Cycle time
2. Operating pressure
3. Chemical dosage
4. Filtrate rate
5. Number of runs
6. lbs./hr./ft.^{2}
7. All lab data
8. Energy consumption
9. Operator hours

NARRATIVE

Slide #

1. Filter presses - the theory and operation.

2. This lesson on filter presses was written by Rawle A. Alloway of Envirc-tech Operating Services, and edited by E. E. "Skeet" Arasmith of Linn-Benton Community College. Instructional design was done by Priscilla Hardin. Mr. Paul H. Klopping was the project director.

3. The filter press is a relatively simple device that has been used in Europe since the 1860's for the purpose of reducing the liquid volume of industrial sludges.

4. In this lesson we will discuss the basics of operational theory, the component nomenclature, step-by-step procedures, operational controls, and monitoring.

5. The filter press is used today because of its ease of operation and ability to give high solids recovery coupled with low moisture content of the cake. It is becoming increasingly popular in the treatment of organic sludge produced by biological sewage treatment processes.

6. In the overall management system, filter presses are classified as volume reduction devices.

7. In order to perform the process of pressure filtration with sewage sludges, the sludges must first be conditioned, usually with some form of coagulant.

8. This conditioned sludge is then pumped into a filtered cloth; pressure is then applied to the sludge by the sludge pump. This pressure squeezes the sludge releasing the liquid through the cloth.

9. This liquid is referred to as filtrate and is usually returned to the plant as a sidestream.

10. With the removal of the water a dry (20% to 50% solids) sludge cake remains within the filter cloth. It is removed manually for ultimate disposal.

11. Keep in mind that the pressing effect comes from the sludge pump and that this system is a batch process.

12. There are two basic types of filter presses: the recess plate (which is the most common), and the plate and frame press. The operation of the two types of filters is the same. Only the equipment differs. Therefore, let's take a few minutes and look at the basic equipment.

13. The basic equipment is made of heavy metal components. That includes legs, side bars, a stationary head, and a movable follower.

14. In the recessed plate type of press, there are a series of grooved recess plates made of cast iron, polypropylene, or a combination of steel and rubber which support the filtering process.

15. Placed over the face of each plate is a filter media usually referred to as a filter cloth. Actually, this media may be nylon, orlon, dacron, paper, felt, polypropylene, or polyvinylchloride.

16. The recess plates and media are squeezed together by an electric hydraulic closing mechanism.

17. This closing mechanism pushes the follower toward the head.

18. Filtration depends upon the pressure on the sludge. The pump supplying the pressure is either a piston ram pump, a progressive cavity pump or an air operated diaphragm pump. The pressure required ranges from 100 to 225 psi.

19. A cutaway view shows that the sludge is pumped into the cavities between the plates. Pressure forces the liquid portion through the media as filtrate. Sludge solids cannot pass through the media and are trapped in the cavities between the plates. As the pumps force more and more sludge through the press, the solids fill the cavities, forming cake.

20. The plate and frame press has basically the same equipment as the recess plate except that instead of recessed plates

21. there are a series of alternating plates and frames. The plates contain the drain grooves and support the media. The frames control the cake thickness.

22. While the recessed plate design produces cake that is 3/4 to 1¼ inches thick, the plate and frame design can produce cakes ranging from 1 to 5 inches thick depending on the depth of the frames.

23. As shown in this cutaway, the plate and frame press does not use the center feed system. Instead, sludge is fed either from the corners, as shown here, or the sides of the frames. Well, so much for the equipment.

24. Let's take a look at the basic operation procedure as performed on a recessed plate.

25. The filtration procedure must start with the press in a closed position.

26. Before filtration, two types of pretreatment procedures are often required: precoating and conditioning.

27. Precoating applies a thin layer of material over the filter media. This is accomplished by pumping a slurry of diatomaceous earth or fly ash into the filter and through the filter media.

28. This thin coat does not retard the filtering capabilities but does reduce media blinding and reduce sludge penetration into the media. This cuts down the frequency of cleaning the media and at the same time improves the ease of cake removal.

29. Most biological sludges require conditioning prior to filtration. The sludge is conditioned by flash mixing with the chemicals in a batch process. Slow stirring the sludge then produces a floc.

30. The stirring is stopped and the floc allowed to settle. The supernatant is returned to the plant as a sidestream.

31. The conditioned sludge is then applied at a high rate (2000 to 3000 gallons per minute with some filters) and at about 25 psi for 10 to 15 minutes.

32. Sludge pumps furnish the pressure that causes the liquid to pass through the filter media into the grooved plates and on to waste.

33. The pressure is increased at about 5 psi intervals every few minutes until operating pressure is reached. This operating pressure could be 100 to 225 psi and will be reached at about 1/4 to 1/3 of the cycle time.

34. The operator observes filtrate rate during the changing cycle. This rate will increase rapidly and then slowly decrease (even though pressure is increasing).

35. As the press fills with cake, the filtration rate will begin to level off. When it reaches approximately 10 to 20 ml/min/ft^2 of filter media, the cycle is over. This usually takes 2 to 4 hours.

36. At the end of the cycle feed, pumps are stopped, the pressure is bled off, and the press is opened.

37. Under normal conditions, the cake would fall from the press as it is opened.

38. However, after repeated use operator involvement may be necessary.

39. The sludge cake must then be disposed of in some manner and the cycle can be restarted.

40. Operational controls are used to obtain optimum filter press production.

41. Production is measured in terms of cake yield. Typical yields for filter presses are 0.1 to 1.0 lbs/hr/ft^2 of media, depending upon the type of solids and conditioning efficiency.

42. Optimum production is obtained by setting goals for filter cake and filtrate quality. The filter cake should range from 20 to 55 percent solids, giving a 90 to 99 percent recovery and the filtrate should be clear.

43. After goals for cake and filtrate quality have been set, one needs to control chemical dosage, pressure, and cycle time to meet these goals. Keep in mind that these three controls are not independent but interrelated, and a change in one may require changes in the other.

44. Chemical dosage is basically controlled by feed solids concentration. Reduced feed solids requires increased chemical dosage.

45. With the same feed solids concentration, a reduction of chemical dosage will require lengthening cycle time.

46. Higher operating pressure will reduce cycle time and produce a drier cake but requires much better floc quality to prevent the deterioration of filtrate quality.

47. An increase in cycle time can reduce the required pressure and produce a drier cake.

48. Optimum sludge cake quality for a given sludge and chemical dosage is obtained by plotting filtrate discharge rate versus time and picking that point where the filtrate discharge levels off. As filtrate rate decreases, solids cake dryness increases.

49. Monitoring filtrate, raw sludge, and sludge cake on each cycle allows operational control for optimum production. Comparison of test results suggests modifications in operational control.

50. The goal is to maintain as dry a sludge as possible while obtaining a filtrate low in suspended solids and BOD, thus reducing the impact on environment and plant operations. To determine if plant performance is meeting this goal an operator should do the following:

51. Compare suspended solids and volatile solids content of feed sludge, filtrate, and cake.

52. Test the feed for alkalinity and dissolved solids. Compare pH of both the feed and filtrate.

53. In order to compare lab results, trend charts showing all lab results should be compared with cycle time, operating pressure, chemical dosage, filtrate flow rates, energy consumption, and total operation hours.

54. In this lesson we discussed the basics of filtration, compared the two types of filter presses, recessed plate and plate and frame.

55. We also observed the operating sequence and discussed operational control and monitoring.

FILTER PRESS

WORKSHEET

1. Filter presses are classified as:
   - ____ a. solids reduction.
   - __X__ b. volume reduction.
   - ____ c. stabilization.
   - ____ d. conditioning.
   - ____ e. None of the above.

2. The filter press usually _____ pretreatment.
   - ____ a. does not require
   - __X__ b. does require
   - ____ c. does not make any difference

3. Binding is defined as:
   - __X__ a. clogging of media.
   - ____ b. securing hay bales.
   - ____ c. mixing of coagulant and blended sludge.
   - ____ d. loss of floc.
   - ____ e. All of the above.

4. Precoat is defined as:
   - ____ a. first coat of winter.
   - ____ b. mixing of diatomaceous earth and a primary coagulant.
   - ____ c. cleaning of the media to prevent binding.
   - __X__ d. application of free-draining, noncohesive material.
   - ____ e. None of the above.

5. From the list below, select <u>two</u> precoat materials.
   - ____ a. polymers
   - ____ b. ferric chloride
   - __X__ c. diatomaceous earth
   - ____ d. alum
   - __X__ e. fly ash

6. The filter press is:

_____a. high energy consumer.
_____b. complicated.
_____c. continuous.
__X__d. batch process.
_____e. All of the above.

7. Arrange the steps below into the proper sequence:

__7__ bleed pressure
__6__ drain
__4__ apply precoat
__8__ drop cake
__5__ apply sludge
__2__ mix precoat
__1__ close press
__3__ condition sludge

8. Select <u>two</u> materials from the list below that are used in filter cloth:

__X__a. nylon
_____b. bronze wire
_____c. ABS plastic
__X__d. polyvinylchloride
_____e. diatomaceous earth

9. Select the typical operating pressure range for pressure filters.

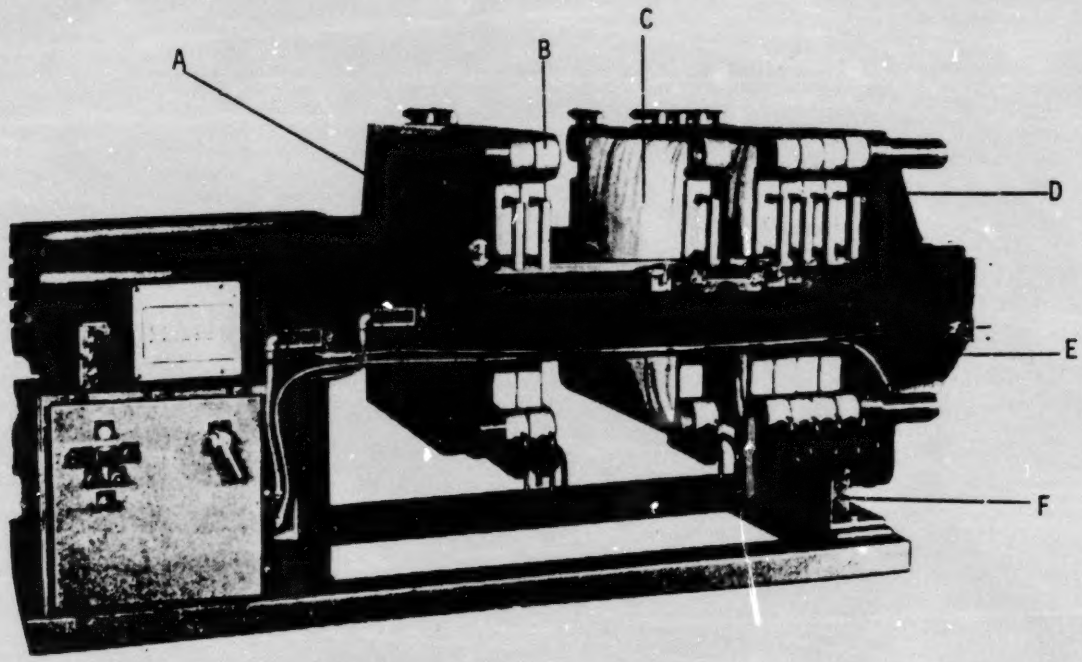
_____a. 10 - 75 psi
__X__b. 100 - 225 psi
_____c. 75 - 150 psi
_____d. 225 - 550 psi
_____e. All of the above.

10. The recessed plate type of press could produce a cake thickness of:

__X__a. 0.75 to 1.5"
_____b. 0.25 to 0.75"
_____c. 1.5 to 3.5"
_____d. None of the above.

11. Match the list of components below with the diagram.

F legs
E frame
D head
A follower
B plates
C filter media



12. The plate and frame type filter press can produce a cake thickness of:

X a. 3 to 5"
___ b. 2 to 3"
___ c. 0.5 to 2"
___ d. 0.25 to 0.75"
___ e. All of the above.

13. The pressure portion of the cycle is completed when:

___ a. the press is full.
X b. the filtrate discharge levels off.
___ c. the pressure goes to maximum.
___ d. the cake is dry.
___ e. None of the above.

14. Typical ckae solids from a filter press would be:

___ a. 20%.
___ b. 30%.
___ c. 40%.
___ d. 50%.
X e. All of the above.

15. Typical solids recovery from a filter press could be:

___ a. 20 to 50%.
___ b. 60 to 80%.
___ c. 80 to 90%.
___ d. 90 to 99%.
___ e. None of the above.

16. Match the operational changes on the left with the results on the right.

a increase operating pressure
b reduction of chemical dosage
b decreased cycle time
b decreased operating pressure

a. increase cake dryness
b. decrease cake dryness

17. Match the test on the left with the sample points on the right.

a, b, c	T.S.S.
a, b, c	V.S.
a	Dissolved solids
a, b	pH
a, b	Alkalinity
c	% moisture

a. Feed
b. Filtrate
c. Cake

18. Place an "X" by those items which should be included in the trend charts. (Select five.)

X	energy consumption
X	operating pressure
	RAS
X	filtrate rates
	WAS
X	chemical dosage
	truck loads of sludge
	jar test frequency
X	cycle time

SLUDGE TREATMENT

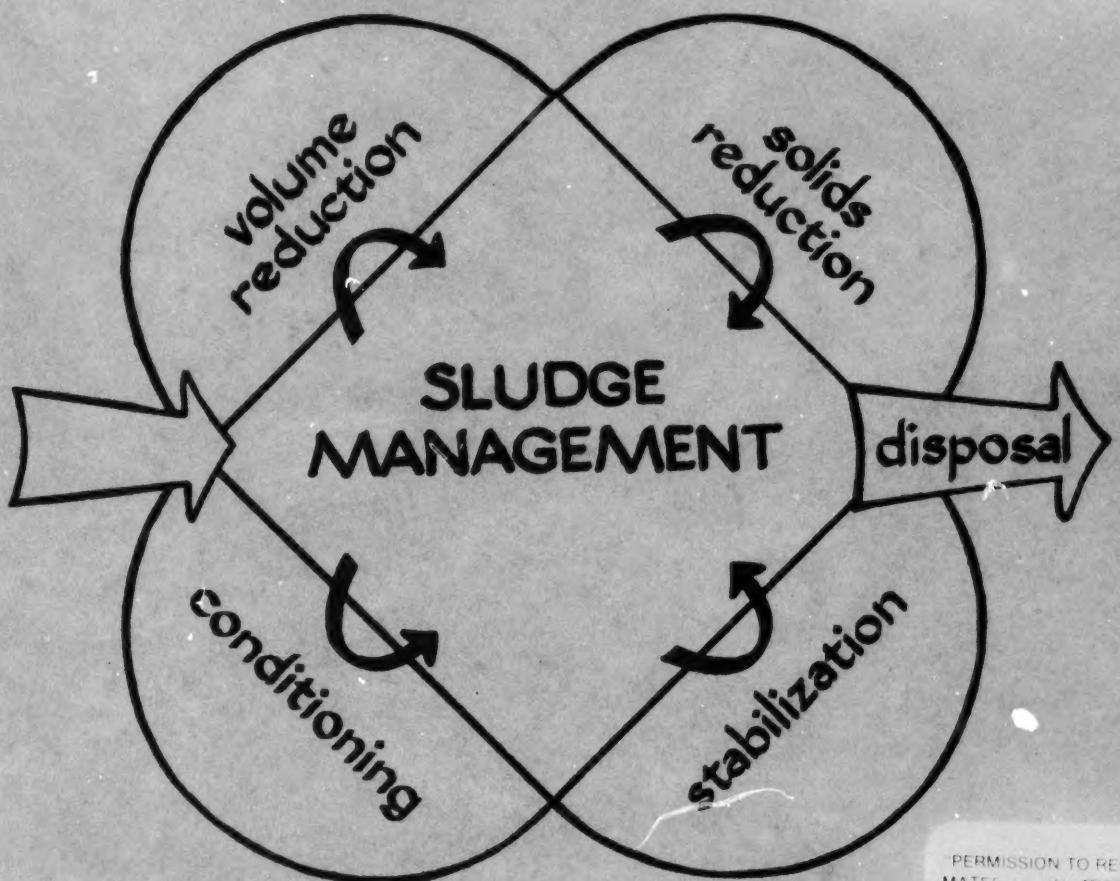
and

DISPOSAL

COURSE # 166

FILTER PRESSES

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION



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STUDENT WORKBOOK

Prepared by
Linn-Benton Community College
and
Envirotech Operating Services

SE 040 062

FILTER PRESSES

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FILTER PRESS

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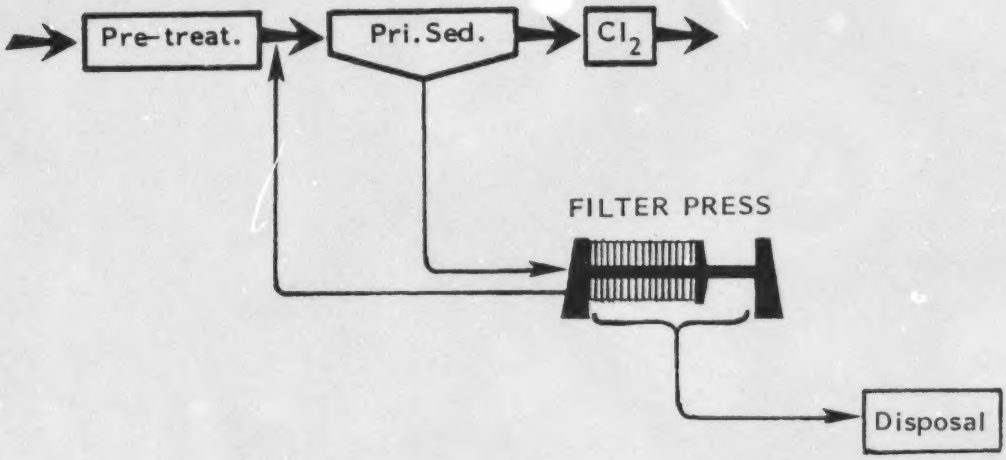
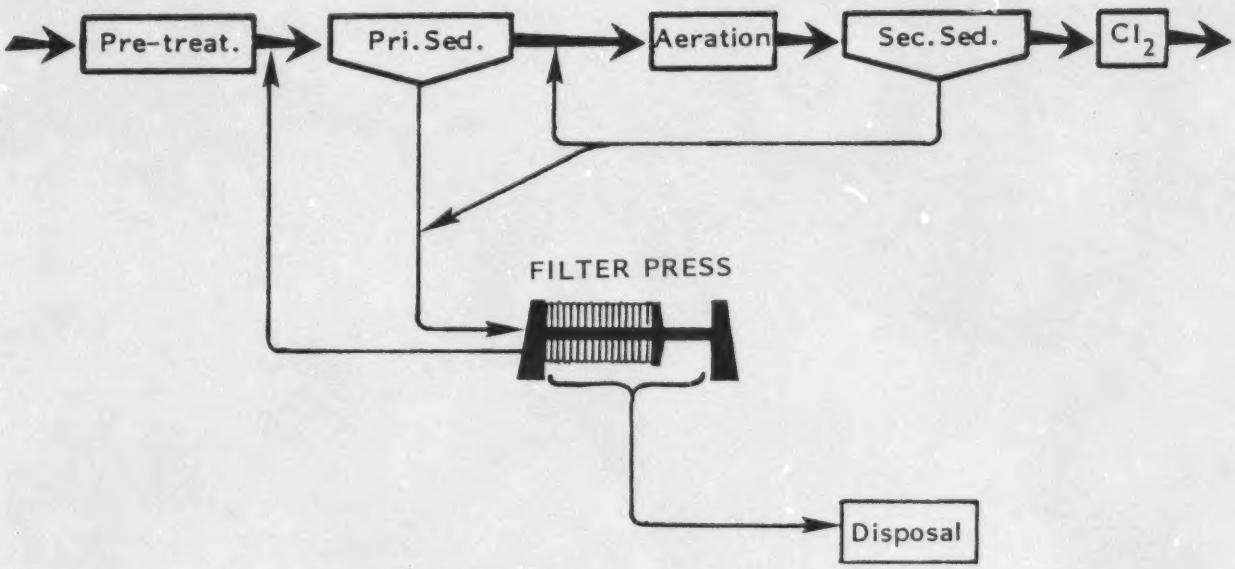
PLANT FLOW DIAGRAMS

PRIMARY PLANT



SECONDARY PLANT



Objectives

Upon completion of this lesson, you should be able to do the following:

1. Recall that the filter press is a volume reduction device.
2. Recall that the filter press usually requires pretreatment.
3. Define binding.
4. Define precoat.
5. Recall two precoat materials.
6. Recall that the filter press is a batch process.
7. Identify the basic components of the two basic types of filter presses.
8. Describe the sequence of operation of the filter press.
9. Recall two materials that are used to produce filter cloths.
10. Recall the typical operating pressure range for a filter press.
11. State the approximate thickness of cake for the two different filter press types.
12. Describe how to determine when the cycle is completed.
13. Recall typical cake solids percentage.
14. Recall typical solids recovery.
15. Given one of the operational variables, describe how its change will effect solids cake and filtrate quality.
16. Identify sampling points and basic control tests.
17. Identify five items which must be included in daily trend charts.

FILTER PRESS

GLOSSARY

Blind - A condition that occurs on cloth or similar filtration media when holes or spaces in the media become clogged or sealed off due to the material being filtered.

Coagulation - (1) The agglomeration (clustering) of colloidal and finely divided suspended matter by the addition to the liquid of an appropriate chemical coagulant, by biological processes or by other means. (2) The process of adding a coagulant and other necessary reacting chemicals.

Filtrate - Liquid that is squeezed from the sludge during the operation of the filter press.

Floc - Small gelatinous masses formed in a liquid by the reaction of coagulants thereto, through chemical of biochemical processes, or by agglomeration.

Flocculation - The coming together of minute particles in a liquid.

Polymer - A high-molecular-weight substance that is formed by either a natural or synthetic process. Natural polymers may be of biological origin or derived from starch products, cellulose derivatives, and alginates. Synthetic polymers consist of simple substances that have been made into complex, high molecular weight substances. Often called a polyelectrolyte.

Precoat - Application of a free-draining, noncohesive material such as diatomaceous earth to a filter media.

Supernatant - Floating on surface, like oil on water.

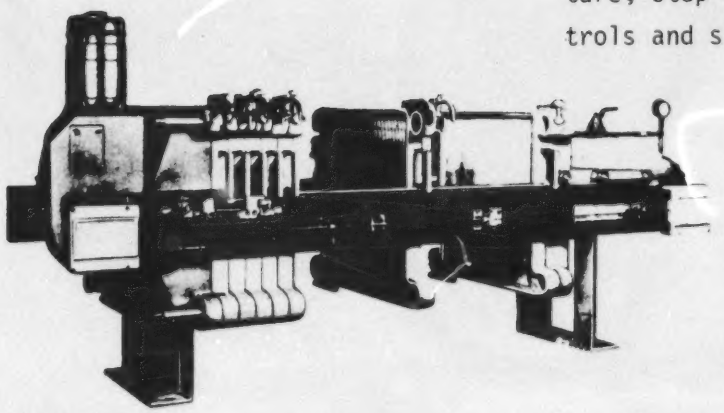
FILTER PRESS

THE BASICS

This lesson on Filter Presses was written by Rawle A. Alloway from Envirotech Operating Services and edited by E. E. Arasmith of Linn-Benton Community College. Instructional design was done by Priscilla Hardin. Mr. Paul Klopping was the project director.

The filter press is a relatively simple device that has been used in Europe since the 1860's for the purpose of reducing the liquid volume of industrial sludges.

In this lesson, we will discuss the basics of the filter operation, the component nomenclature, step-by-step process, operational controls and sampling and testing.



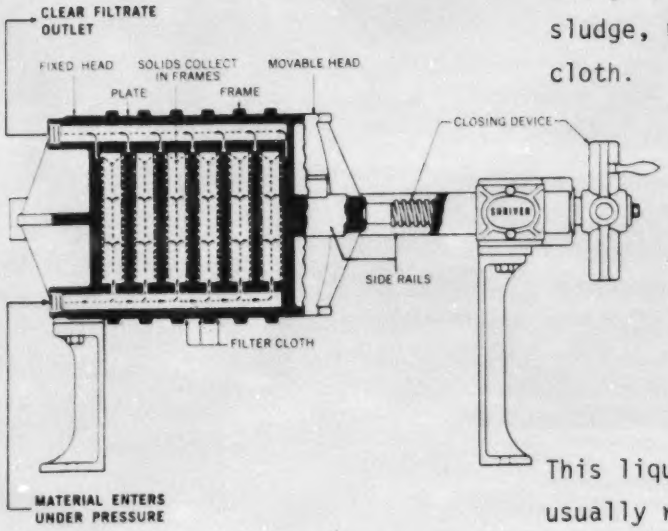
Because of its ease of operation and ability to give high solids recovery and coupled with low moisture content of the cake, it is becoming increasingly popular in the treatment of organic sludge produced by biological sewage treatment processes.

In the overall solids management system, filter presses are classified as volume reduction devices.

In order to perform the process of pressure filtration with sewage sludges, the sludges must first be conditioned, usually with some form of coagulant.

This conditioned sludge is then pumped into a filter cloth that is placed between two static plates.

Pressure is applied to the sludge via the sludge pump. This pressure squeezes the sludge, releasing the liquid through the cloth.



This liquid is referred to as filtrate and is usually returned to the plant flow as a side stream.

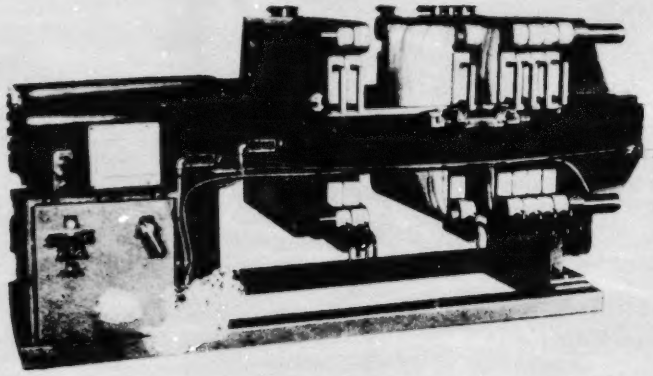
With the removal of a portion of the water a day (20-50% Solids), sludge cake remains within the filter cloth. This cake is removed by separating the press plates and allowing the cake to fall out.

The cake must then proceed to some type of ultimate disposal process.

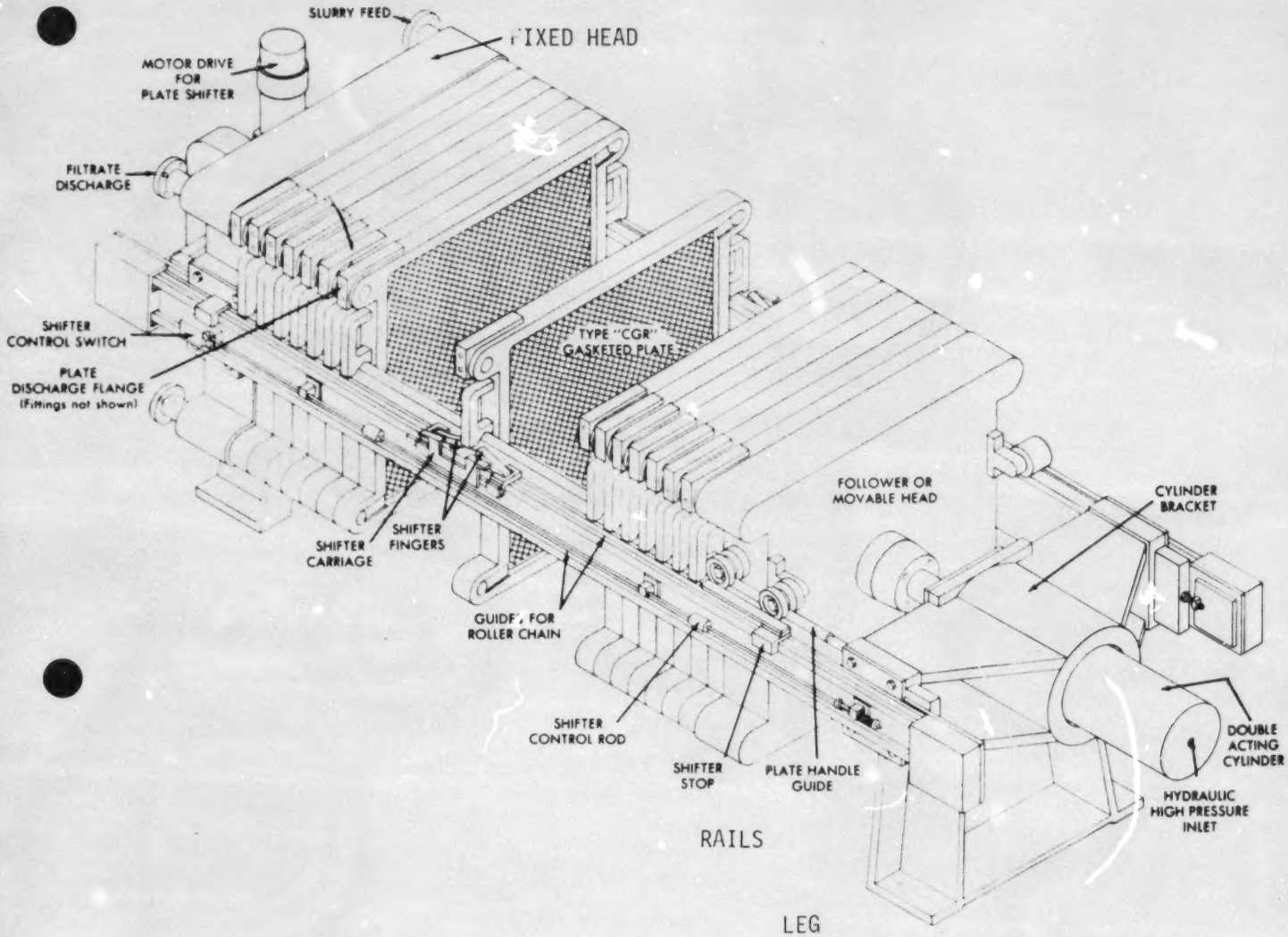
It should be kept in mind that the press's effect is applied by the sludge pressure and that this system is a batch process.

There are two basic types of filter presses. The recessed plate (which is the most common) and the plate and frame press. The operation of the two types of filters are the same. Only the equipment differs. Therefore, let's take a few minutes and look at the basic equipment. First, the recessed plate.

PLATE AND FRAME

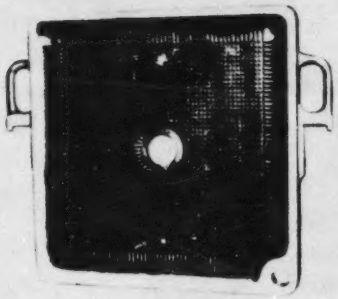


The recessed type is the most common press and will produce a sludge cake of 0.75 to 1.5 inches in thickness.



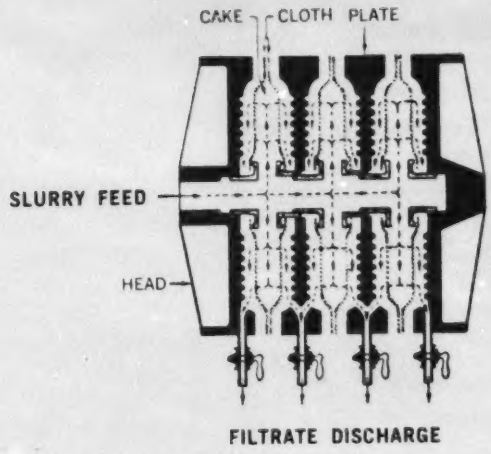
The basic equipment would include the legs, usually made of steel; side bars, made of cast iron; a head, which is stationary and made of cast iron; and a follower, which is also made of cast iron, but is movable.

There needs to be some type of closing mechanism with the capability of producing 3500 psi and is operated either manually on the small demos or electrically or hydraulically on the larger devices.



There is a series of recessed plates which could be made of cast iron, polypropylene, or steel and rubber.

These plates contain a series of small grooves used to drain the filtrate. Sludge is fed down the center of the plates.

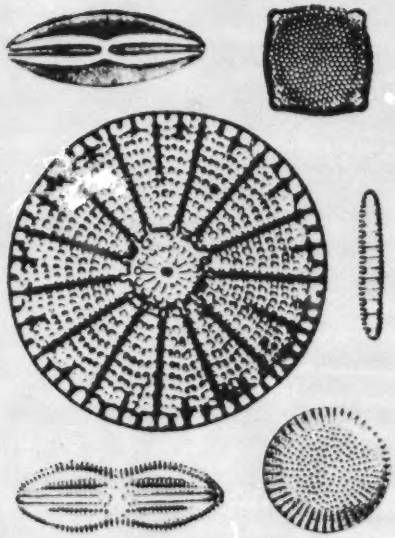


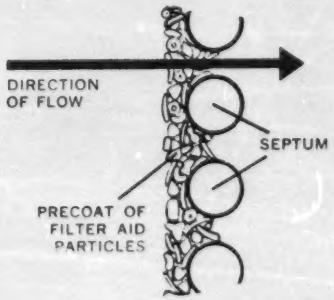
Placed over the face of each plate is a filter media, usually referred to as a filter cloth. Actually, this media may be nylon, orlon, dacron, paper, felt polypropylene, or polyvinylchloride.

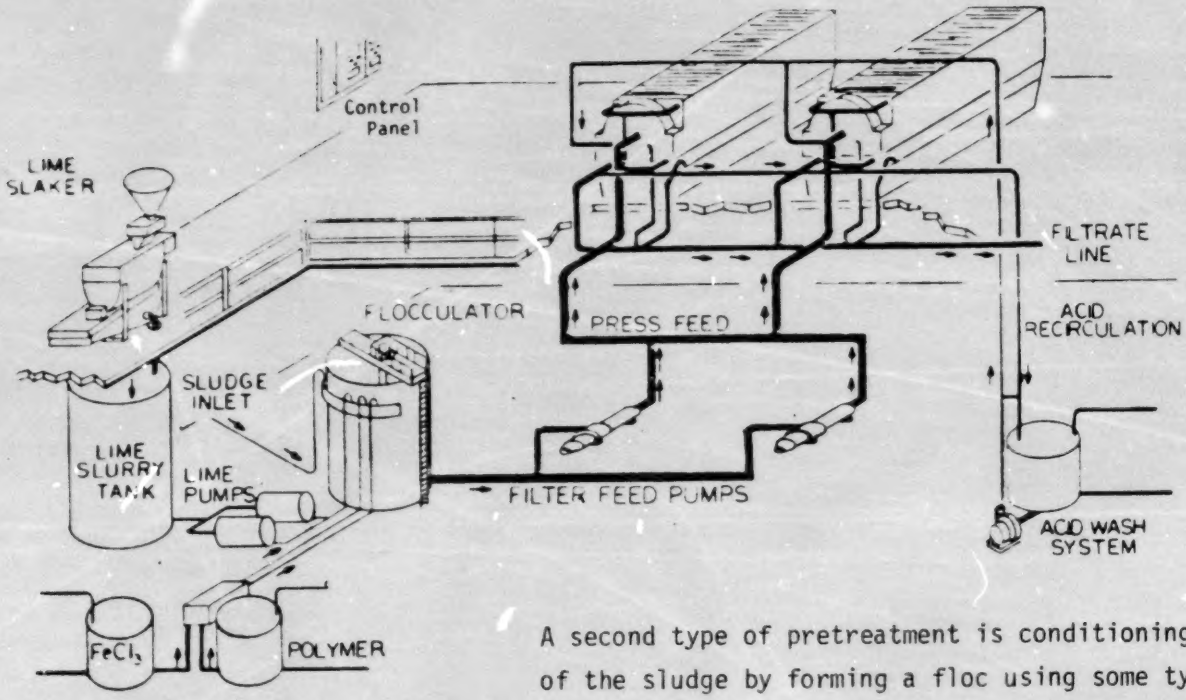
In order to produce the pressure necessary, a pump capable of delivering 100-225 psi may be required. Usually, the pump chosen for this job is either an air operated diaphragm or a piston ram.

PRETREATMENT

As mentioned earlier, some type of pretreatment is usually required when pressing biological sludge. One form of pretreatment is the precoating of the filter media with fly ash or diatomaceous earth. This procedure will usually reduce cleaning frequency, media binding and ease removal of the cake.







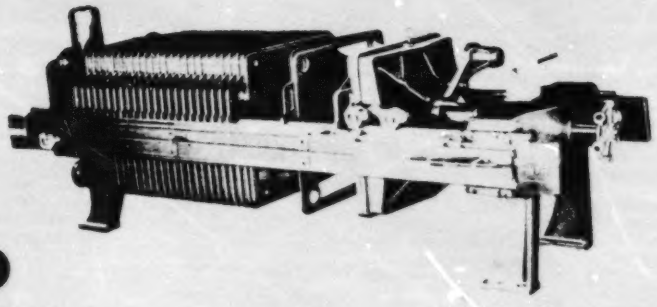
CONDITIONING

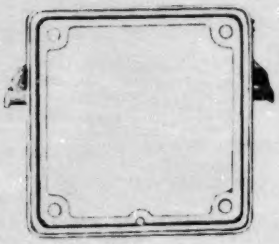
A second type of pretreatment is conditioning of the sludge by forming a floc using some type of primary coagulant. This will improve solids recovery and filtrate quality.

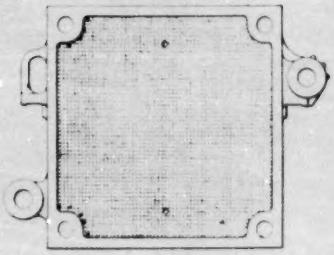
Conditioning will usually require some chemical storage, chemical feed pumps, lime equipment and a flocculator.

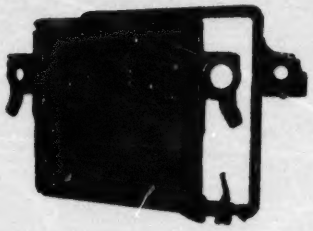
The plate and frame press has basically the same equipment as the recessed plate, except that instead of the recessed plates . . .

PLATE AND FRAME



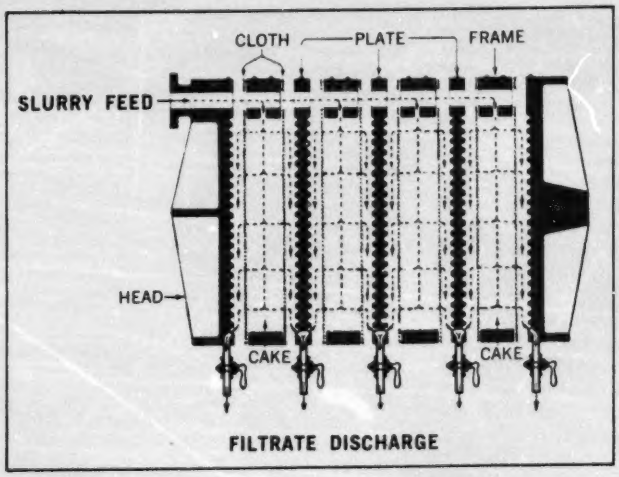




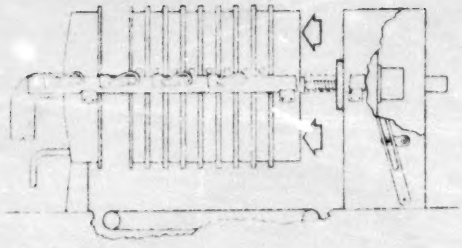


there is a series of alternating plates and frames.

The plates contain the drain grooves and support the media. The frames control the cake thickness. A cake thickness of 1 to 5 inches may be obtained. The plate and frame press does not use the center feed system. Instead, sludge is fed either from the corners or the side of the frames. Well, so much for the equipment. Let's take a look at the basic operation procedure.



PROCEDURE



To start with, the press must be in a closed position.

The precoat material (if used) is then mixed.

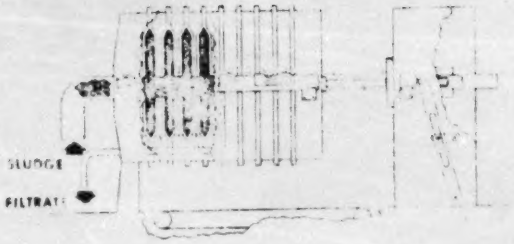
The sludge is then conditioned using the coagulation and flocculation methods. The most common coagulation, flocculation process utilizes ferric chloride and lime, although some facilities use combinations of alum and polymers or polymers added to the ferric chloride-lime process.

The sludge is conditioned by flash mixing with chemicals in a batch process. The sludge is then slow-stirred to develop a floc.

The stirring is stopped and the floc allowed to settle. The supernatant is returned to the plant as a side stream. This supernatant should be tested for BOD and S.S.

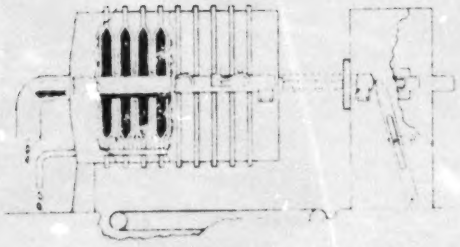
The jar test is used to determine the proper chemical dosages.

The sludge is now ready to feed; but first, the precoat must be applied



Then, the sludge is applied at a high rate (2,000 - 3,000 gpm with some filters) and at about 25 psi for 10 to 15 minutes.

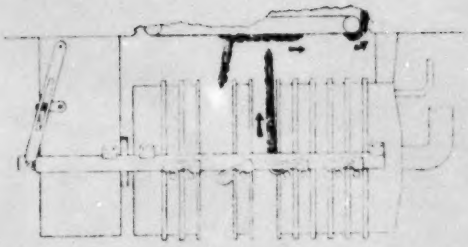
The pressure is increased at about 5 psi intervals every few minutes until the operating pressure is reached. This could be 100 - 225 psi and will be reached at about 1/4 to 1/3 of the cycle time.



This pressure will cause the liquid to pass through the filter media into the plate grooves and on to waste.

The operator observes filtrate rate during the changing cycle. This rate will increase rapidly and then slowly decrease (even though pressure is increasing).

The filtrate rate will begin to level off. When it reaches 10-20 ml/min/ft^2 of media, the cycle is over. This usually takes two to four hours.



The filtrate is returned to the plant and may cause some operational problems.

At the end of the cycle, the feed pumps are stopped and the pressure is bled off.

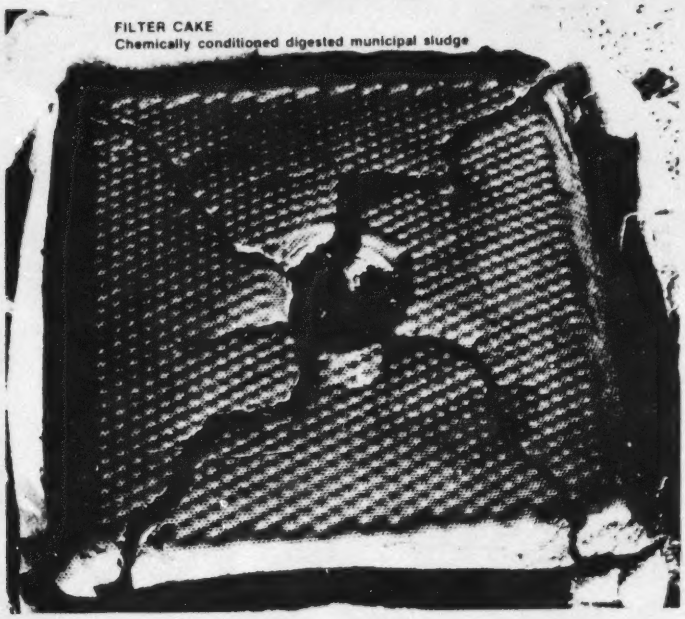
The cake is then removed to be disposed of and the process started over.

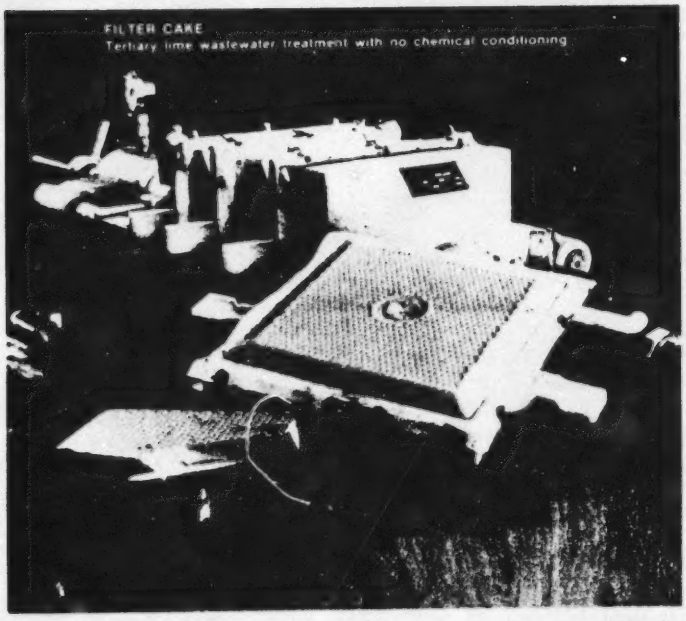
After several cycles, the media may become clogged and require washing. The media may be cleaned with a high pressure acid spray; or the media may have to be removed and washed, then replaced.

OPERATIONAL CONTROLS

Operational controls are used to obtain optimum filter press production. Production is measured in terms of ckae yield. Typical yield for filter presses are 0.1 to 1.0 lbs/ hr/ft^2 of media depending upon type of solids and conditioning efficiency.

Optimum production is obtained by setting goals for filter cake and filtrate quality. The filter cake should range from 20 to 55% solids giving a 90 to 99% recovery and the filtrate should be clear.





Keep in mind that these three controls are not independent, but interrelated; and a change in one may require changes in the other.

Higher operating pressure will reduce cycle time and produce a dryer cake but requires much better floc quality to prevent the deterioration of filtrate quality.

Chemical dosage is basically controlled by feed solids concentration. Reduced feed solids requires increased chemical dosages.

With the same feed solids concentration a reduction of chemical dosage will require lengthening cycle time.

An increase in cycle time can reduce the required pressure and produce a dryer cake.

Optimum sludge cake quality for a given sludge and chemical dosage is obtained by plotting filtrate discharge rate vs. time and picking that point where the filtrate discharge levels off As filtrate rate decreases, solids cake dryness increases.

SAMPLING AND TESTING

In order to obtain the optimum production, samples of filtrate, raw sludge and cake should be collected during each cycle and compared as follows.

Total solids and volatile solids content of raw, filtrate and cake should be compared.

PH of both the raw and filtrate should be compared as well as . . .

testing the raw for alk., and total dissolved solids.

In order to compare lab results, trend charts showing all lab results should be compared with . . .

cycle time, operating pressure, chemical dosage, filtrate rates lbs./hr./ft.^{2}, energy consumption and total operator hours.

SUMMARY

In this lesson, we discussed the basics of filtration, compared the two types of filter presses, recessed plate and the frame and plate.

We also observed the operating sequences as well as discussed operational control, sampling and testing.

References

1. Operation of Wastewater Treatment Plants, Sacramento State College, 2nd ed.

2. MOP 11 Operation of Wastewater Treatment Plants, p. 314-316. Water Pollution Control Federation, Washington D.C.

3. Process Design Manual - Sludge Treatment and Disposal, US EPA 625/1-79-011.

4. Operations Manual, Sludge Handling and Conditioning; US EPA 430/9-78-002

FILTER PRESS

WORKSHEET

1. Filter presses are classified as:
   _____a. solids reduction.
   _____b. volume reduction.
   _____c. stabilization.
   _____d. conditioning.
   _____e. None of the above.

2. The filter press usually _____ pretreatment.
   _____a. does not require
   _____b. does require
   _____c. does not make any difference

3. Binding is defined as:
   _____a. clogging of media.
   _____b. securing hay bales.
   _____c. mixing of coagulant and blended sludge.
   _____d. loss of floc.
   _____e. All of the above.

4. Precoat is defined as:
   _____a. first coat of winter.
   _____b. mixing of diatomaceous earth and a primary coagulant.
   _____c. cleaning of the media to prevent binding.
   _____d. application of free-draining, noncohesive material.
   _____e. None of the above.

5. From the list below, select <u>two</u> precoat materials.
   _____a. polymers
   _____b. ferric chloride
   _____c. diatomaceous earth
   _____d. alum
   _____e. fly ash

6. The filter press is:

_____a. high energy consumer.
_____b. complicated.
_____c. continuous.
_____d. batch process.
_____e. All of the above.

7. Arrange the steps below into the proper sequence:

_____ bleed pressure
_____ drain
_____ apply precoat
_____ drop cake
_____ apply sludge
_____ mix precoat
_____ close press
_____ condition sludge

8. Select two materials from the list below that are used in filter cloth:

_____a. nylon
_____b. bronze wire
_____c. ABS plastic
_____d. polyvinylchloride
_____e. diatomaceous earth

9. Select the typical operating pressure range for pressure filters.

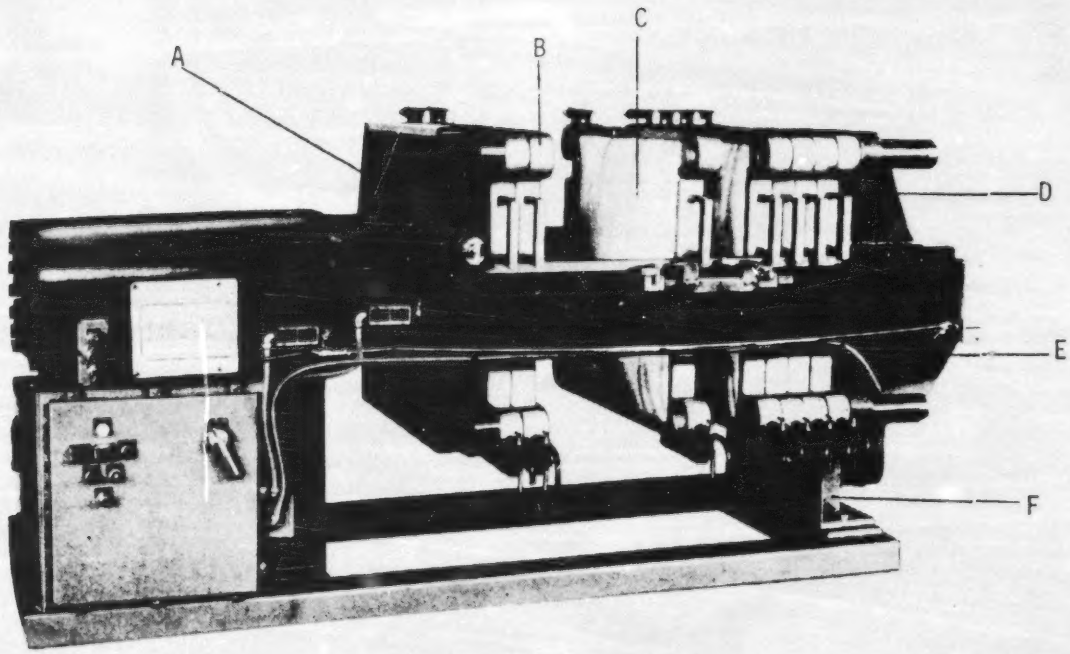
_____a. 10 - 75 psi
_____b. 100 - 225 psi
_____c. 75 - 150 psi
_____d. 225 - 550 psi
_____e. All of the above.

10. The recessed plate type of press could produce a cake thickness of:

_____a. 0.75 to 1.5"
_____b. 0.25 to 0.75"
_____c. 1.5 to 3.5"
_____d. None of the above.

11. Match the list of components below with the diagram.

_____ legs
_____ frame
_____ head
_____ follower
_____ plates
_____ filter media



12. The plate and frame type filter press can produce a cake thickness of:

_____a. 3 to 5"
_____b. 2 to 3"
_____c. 0.5 to 2"
_____d. 0.25 to 0.75"
_____e. All of the above.

13. The pressure portion of the cycle is completed when:

_____a. the press is full.
_____b. the filtrate discharge levels off.
_____c. the pressure goes to maximum.
_____d. the cake is dry.
_____e. None of the above.

14. Typical ckae solids from a filter press would be:

_____a. 20%.
_____b. 30%.
_____c. 40%.
_____d. 50%.
_____e. All of the above.

15. Typical solids recovery from a filter press could be:

_____a. 20 to 50%.
_____b. 60 to 80%.
_____c. 80 to 90%.
_____d. 90 to 99%.
_____e. None of the above.

16. Match the operational changes on the left with the results on the right.

_____ increase operating pressure
_____ reduction of chemical dosage
_____ decreased cycle time
_____ decreased operating pressure

a. increase cake dryness
b. decrease cake dryness

17. Match the test on the left with the sample points on the right.

_____ T.S.S.
_____ V.S.
_____ Dissolved solids
_____ pH
_____ Alkalinity
_____ % moisture

a. Feed
b. Filtrate
c. Cake

18. Place an "X" by those items which should be included in the trend charts. (Select five.)

_____ energy consumption
_____ operating pressure
_____ RAS
_____ filtrate rates
_____ WAS
_____ chemical dosage
_____ truck loads of sludge
_____ jar test frequency
_____ cycle time